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POULTRY DISEASES ACTIVITIES REPORT 1965

CONTENTS

Page

Foreword ii
Program support--Hyattsville, Md 1
  Salmonella 1
  Cooperative state-federal pullorum disease and fowl typhoid reporting system 2
  Cooperative state-federal market poultry identification and disease eradication by traceback 2
  Mycoplasma gallisepticum antigen 2
Specific pathogen-free poultry program--Maine 4
  History 4
  Materials and methods 5
  Conclusions and results 7
Infectious sinusitis program--Minnesota 8
  History of disease 8
  Description of the disease 9
  Preliminary field study 9
  Control program 10
  Program progress 12
  Future work 12
  Literature cited 13
The avian leukosis complex 13
  History of the diseases 13
  Indiana flock studies 14
  Michigan epidemiological studies 15
The Virginia broiler production improvement program 15
  Objectives 16
  Plan of Work 16
  Progress 16
Market poultry identification for eradicating avian tuberculosis 16
  Ojectives 17
  Plan of Work 17
  Progress 17

Agricultural Research Service
United States Department of Agriculture

FOREWORD

The Economic Research Service, USDA, advises us that gross farm income from poultry and poultry products in the United States is approximately \$3½ billion annually (1958-64). Diseases cost poultrymen about \$300 million of their income each year. In many States these disease losses have an important effect upon the overall farm income. Thirteen States now derive more than a quarter of their gross farm income from poultry products, and in four States poultry and poultry products are the chief source of farm income.

Rapid expansion has taken place in the industry as a result of wide-scale increase in the consumption of poultry. From 1940 to 1964, the per capita consumption of red meats increased 22 percent while that for poultry increased 125 percent. Research in nutrition and genetics has developed faster growing meat birds and high producing laying hens. New techniques in housing and management have increased production while saving labor.

In many ways, the control and eradication of poultry diseases have not kept pace with current developments in other aspects of the industry. Broad-scale disease eradication programs have often been neglected in favor of drugs and vaccines.

The importance of poultry diseases that are transmissible to humans and their effect upon the health of the human population cannot be overlooked. Salmonellosis, ornithosis, erysipelas, and Newcastle disease are in this category. Some of the poultry diseases causing considerable economic concern to the industry today (1965) are those caused by Salmonellae, Mycoplasma, and the leukosis complex. The Animal Health Division (ANHD) is cooperating with State and Federal agencies in various studies and projects designed to lessen losses from these diseases. In recent years, leukosis is being reported more frequently. For example, post mortem condemnations have gone from 6 percent of the total poultry condemned at federally inspected plants in 1962 to 10 percent in 1963, and jumped to more than 18 percent in 1964. Our cooperating states and ANHD are hoping to find the reasons for this.

Since 1935 routine testing has reduced the incidence of pullorum disease and fowl typhoid to a very low level. These diseases can be completely eradicated with a little extra effort.

Finding Salmonella in feeds and in feed ingredients has caused great concern to the feed and poultry industries. Public health officials believe that poultry and other domestic animals are the reservoirs of Salmonella infection in humans. Many countries that import our poultry products are now requiring certification that the poultry has been produced free of several common poultry diseases.

These are only a few of the problems that face the poultry industry today. Details of some of the cooperative State-Federal activities that lessen poultry disease losses are described in the following pages.

F J Mulhern
Director
Animal Health Division

SYMBOLS USED IN REPORT

ANHD. . . . . Animal Health Division
ADPRD. . . . Animal Disease and Parasite Research Division
ALC. . . . . . Avian Leukosis Complex
CRD. . . . . . Chronic Respiratory Disease
HA. . . . . . . Hemagglutination antigen
HI . . . . . . Hemagglutination inhibition test
IS . . . . . . Infectious sinusitis
NADL. . . . National Animal Disease Laboratory
NPIP . . . . National Poultry Improvement Plan
PPLO-S_6 . Pleuropneumonia-like organism--S_6 strain
SPF . . . . . . Specific pathogen free

POULTRY DISEASES ACTIVITIES REPORT 1965

PROGRAM SUPPORT--HYATTSVILLE, MD.

The Poultry Diseases Staff, Animal Health Division (ANHD), Agricultural Research Service (ARS), Hyattsville, Md., is responsible for coordinating cooperative State-Federal poultry disease projects with the various States. The projects are described in detail in this report by those personnel who are most familiar with the respective programs.

The basic responsibilities of the Poultry Diseases Staff are to develop and recommend plans on the conduct of cooperative poultry disease programs. The Staff must evaluate field operations and coordinate planning for maximum efficiency, effectiveness, and economy.

In addition, the role of feed and feed ingredients is studied and evaluated as a means of transmitting diseases to all species of animals. The Staff consults with the industry, research workers, State officials, and other agencies on poultry disease problems.

Finally, the Poultry Diseases Staff must keep informed of domestic and international research on diseases in which the U.S. Department of Agriculture has an interest and especially foreign poultry diseases that pose a threat to our nation's poultry industry.

SALMONELLA

Feeds and Feed Ingredients

The presence of disease producing germs such as Salmonellae in livestock and poultry feeds and in animal, poultry, and fish byproducts has been a cause of increasing concern for some time.

Cooperative work with State disease control officials and representatives from all industries concerned with the production of livestock and poultry feeds has resulted in the development, publication, and distribution of product-handling guidelines ("Recommended Sanitation Guidelines for Processors of Poultry and Animal Byproducts," ARS 91-47, and "Sanitation Guidelines for Salmonella Control in Processing Industrial Fishery Products," ARS 91-51).

A Salmonella Information Kit has been distributed to all State-Federal disease control veterinarians and diagnostic laboratories doing Salmonella isolations. It contains current ARS information on Salmonella.

A seminar by ARS scientists and researchers with extensive Salmonella experience from institutions throughout the country was held at ANHD headquarters, Hyattsville, Md., in May 1964. Recommendations by these workers were for increased research, initiation of a control program, and national reporting.

Proposals for Controlling Salmonella

Based upon recommendations given at the seminar, the ANH Division is considering the following proposals to solve the Salmonella problem.

1. Provide Salmonella-serotyping facilities to accommodate all animal diagnostic laboratories.

2. Assist State agencies with epidemiology of salmonellosis in livestock and poultry.
3. Cooperate with feed and feed-ingredient industries to prevent Salmonella contamination.
4. Compile and distribute a national incidence report of salmonellosis in livestock and poultry. This report will enable the Division to determine economic significance of the contamination and provide statistical information for research and epidemiology.

Salmonella Serotyping

Serotyping is essential to the epidemiology of salmonellosis. Poultry pathologists have submitted nearly 80 percent of all Salmonella cultures. Therefore, the responsibility of coordinating a serotyping laboratory has been given to the Poultry Diseases section of ANHD. The demand for this service has exceeded our facilities, and preparations are now being made to add three small regional serotyping laboratories to supplement the serotyping center at the National Animal Disease Laboratory (NADL).

COOPERATIVE STATE-FEDERAL PULLORUM DISEASE AND FOWL TYPHOID REPORTING SYSTEM

The Pullorum Disease and Fowl Typhoid Reporting System started in May 1962, at the request of the American Poultry and Hatchery Federation, the Poultry Breeders of America, and State and Federal livestock disease control officials.

The reporting system requests all private and public poultry disease diagnostic laboratories to report isolations of the causative agents of pullorum disease and fowl typhoid.

This reporting system is necessary to locate flocks and hatcheries infected with pullorum disease and fowl typhoid; to determine the number of infected flocks not being disclosed by regular testing techniques; and to provide a readymade procedure of notifying disease control officials of isolations from within their own States or from other States (table 1).

Forty-nine States, Puerto Rico, and the Virgin Islands now agree to report isolations and/or followup investigations to The National Poultry Improvement Plan (NPIP) or to the Animal Health Division.

COOPERATIVE STATE-FEDERAL MARKET POULTRY IDENTIFICATION AND DISEASE ERADICATION BY TRACEBACK

Early in fiscal year 1964, preliminary meetings were held at Hyattsville, Md., to discuss the feasibility of a pilot project for identification of market poultry so that (1) the source of any infection could be traced and (2) a method of monitoring poultry flocks could be developed.

The Virginia Department of Agriculture is now cooperating in this pilot study. (See p. 15).

MYCOPLASMA GALLISEPTICUM ANTIGEN

The responsibility of initiating uniform diagnostic procedures for the detection of Mycoplasma gallisepticum (PPLO-S_6) in poultry was given to the Technical Services Staff, Beltsville, by the Director of Animal Health Division.

TABLE 1.--Summary of pullorum and typhoid isolations, 1964 in comparison with 1963 followup investigations[1]
(Figures in parentheses indicate number of followup investigations reported)

Regions	1964												1963	
	PULLORUM					TYPHOID					Grand total	Followup investigations	Grand total	Followup investigations
	Under 3 wks.	3 wks. to 5 mo.	Over 5 mo.	Age not reported	Total	Under 3 wks.	3 wks. to 5 mo.	Over 5 mo.	Age not reported	Total				
	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Number	Percent	Number	Percent
N. Atlantic[2]-------	10 (6)	3 (2)	9 (7)	0 (0)	22 (15)	1 (1)	2 (1)	10 (8)	0 (0)	13 (10)	35 (25)	72	27 (19)	70
E. N. Central[3]-----	8 (4)	8 (6)	10 (9)	0 (0)	26 (19)	0 (0)	1 (1)	1 (1)	0 (0)	2 (2)	28 (21)	75	40 (22)	55
W. N. Central[4]-----	4 (3)	0 (0)	9 (6)	1 (0)	14 (9)	0 (0)	0 (0)	8 (1)	3 (2)	11 (3)	25 (12)	48	81 (7)	9
S. Atlantic[5]-------	15 (4)	20 (1)	49 (15)	0 (0)	84 (20)	11 (5)	6 (3)	16 (6)	0 (0)	33 (11)	117 (34)	26	104 (67)	64
S. Central[6]--------	15 (10)	8 (5)	16 (8)	0 (0)	39 (23)	1 (1)	2 (2)	14 (9)	8 (0)	25 (12)	64 (35)	55	58 (22)	38
Western[7]-----------	4 (4)	0 (0)	2 (2)	0 (0)	6 (6)	0 (0)	0 (0)	1 (1)	0 (0)	1 (1)	7 (7)	100	18 (11)	61
United States------	56 (31)	39 (14)	95 (47)	1 (0)	191 (92)	13 (7)	11 (7)	50 (26)	11 (2)	85 (42)	276 (134)	48	328 (148)	45

[1] From Animal Husbandry Research and Animal Health Divisions, ARS, as reported by cooperating laboratories.
[2] Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.
[3] Illinois, Indiana, Michigan, Ohio, and Wisconsin.
[4] Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.
[5] Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia.
[6] Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas.
[7] Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Development of Uniform Production and Testing Procedures

During the first half of fiscal year 1964, consultations were held with poultry research scientists from Animal Disease and Parasite Research Division (ADPRD), State researchers in California, Connecticut, Georgia, Iowa, Minnesota, and Texas. A laboratory was developed at Beltsville, Md., preliminary cultures were adapted to suitable media, and standard production and testing procedures were initiated.

Production of a Standard Antigen

By January 1965 the Technical Services Staff had produced and distributed 3,046,280 test doses of plate antigen; 1,592,500 test doses of tube antigen; and 608,000 test doses of hemagglutination (HA) antigen. The antigen went to 33 States and Canada for experimental or field trial usage. Also, reference sera, both positive and negative, from checkens and turkeys were produced for various laboratories. Cultures of M. gallisepticum and reference sera were made available to commercial laboratories. The production of reference sera and HA antigen will continue at Beltsville until they become available commercially.

Field Evaluation of Antigen

Flock evaluation forms were developed and furnished to all laboratories applying diagnostic tests for M. gallisepticum. During the last half of fiscal year 1965, concentrated efforts were made to follow up and summarize field data on the efficacy of the USDA standard antigens. This evaluation will be completed in fiscal year 1966.

Technical Training and Surveillance of Testing Methods

Scheduled training schools were held in Arizona, California, Georgia, Iowa, Kansas, Louisiana, Maine, Maryland, Minnesota, New York, Ohio, Virginia, and Wyoming. At these schools State, Federal, and privately employed technicians at diagnostic laboratories were instructed in the techniques of uniform testing procedures. Technical training and consultations on testing methods are being continued to maintain national uniformity of diagnostic technique.

SPECIFIC PATHOGEN-FREE POULTRY PROGRAM--MAINE

The growth of the poultry industry during the past few years has been due to efficiency in production, better genetic material, improved nutrition, and an expanding market. Accompanying these advances have been disease problems, many of which have been partially solved.

Since 1959, the law requires that poultry meat shipped in interstate commerce be inspected for wholesomeness by the U.S. Department of Agriculture. The poultry disease problem throughout the nation was accentuated when large lots of poultry meat were condemned.

HISTORY

The idea of raising germ-free chickens probably originated before the turn of the century. However, the application of this principle first reached practical reality in July 1961 when Maine launched the SPF (Specific Pathogen-Free) Poultry Program.

H. L. Chute of the University of Maine is the originator of the creative thinking and enthusiasm that developed this program. Since its initiation, this has been a cooperative program with the Animal Health and the Animal Disease and Parasite Research Divisions of the U.S. Department of Agriculture, the Maine Department of Agriculture, the University of Maine, and the Maine poultry industry.

The first objective of this group was to produce breeding stock free of CRD (chronic respiratory disease) caused by a pathogen strain of PPLO (pleuropneumonia-like organism referred to as the S_6 strain, now known as Mycoplasma gallisepticum).

PPLO-free parent stock became available in 1961, and sizable lots of broilers were hatched and raised under SPF requirements. Table 2 reflects the growth of the SPF broiler production in Maine. Drs. Douglas Stauffer, Richard Reese, and Arlan Freeman, ANH Poultry Epidemiologists, have been assigned to coordinate the field phase of the program.

MATERIALS AND METHODS

SPF Breeder Program

In developing PPLO-S_6-free breeding hens, workers pursued a number of husbandry changes. The first eggs for such a flock were obtained from adult hens 2 years of age or older. It was assumed that these birds would have a low transmission rate of PPLO. The eggs were dipped twice in 800 parts per million of erythromycin. The first dip was performed on the eggs at room temperature. For the second dipping the eggs were heated in an incubator 8 hours at 99.5° F., then dipped into the antibiotic solution at a temperature not exceeding 55°. At hatching time the chicks were injected with 5 mg. of gallimycin. The first flock was placed in a new poultry house and tested for PPLO at monthly intervals by whole blood, serum plate, and tube agglutination tests to determine the disease status. From this point on, no antibiotics or drugs were used in the production of PPLO-free stock. However, the husbandry and management practices listed below were followed by all breeding farms classified as specific pathogen-free flocks:

1. Houses must not have dirt floors.
2. All houses must be screened (maximum mesh, 1 in.) against wild birds.

TABLE 2.--Specific pathogen-free poultry production in Maine, 1960-65

Chickens and year	Flocks	Birds
PPLO-S_6-free breeding stock:	Number	Number
1960	1	6,500
1961	3	21,700
1962	20	70,960
1963	23	151,400
SPF broilers:		
1962	28	601,700
1963	65	1,009,200
1964	90	1,503,000
1965 (estimated)	120	2,000,000

3. All houses must be provided with doors that lock and are kept locked at all times.
4. Bins for bulk feed must be filled from outside filler pipes. No feed shall be delivered in bags.
5. Oil tanks inside building must be filled from outside filling pipes.
6. All poultry houses must be located no closer than 100 ft. to public highways and not closer than 1,000 ft. to poultry houses on adjacent premises.
7. All poultry houses must be located at least 1,000 ft. from poultry litter piles or other vermin-attracting debris.
8. The farm must have an approved disposal pit or incinerator for dead birds.
9. Each poultry house should have a pan of an approved disinfectant and a stiff brush in the grain room, next to the door. The disinfectant solution should be changed at least once daily. The caretaker must use this to clean his footwear upon entering or leaving the house.
10. Only clean sawdust or litter should be used and should be delivered in clean trucks.
11. Each house must be thoroughly cleaned and disinfected with an approved disinfectant prior to the introduction of baby chicks. A list of the approved disinfectants will be provided by the caretaker.
12. No tractors, dump trucks, or other equipment used in connection with the poultry enterprise can be borrowed from or loaned to other farms for the duration of this contract.
13. Chicks must originate from NPIP clean flocks.
14. Baby chicks shall be delivered in new or disinfected shipping equipment directly from the hatchery by attendants wearing freshly laundered caps and coveralls and disinfected shoes.
15. No vaccinations or medications can be carried out for the duration of this agreement unless mutually agreed upon by the parties hereto.
16. Such medications as coccidiostats (chemicals only) as are currently used will be premixed in the feed prior to delivery.
17. Only one age of birds will be permitted on a farm. No pet birds or other poultry will be allowed.
18. Poultry meat and eggs for home consumption shall be purchased in grocery stores only.
19. No domestic animals shall be permitted to enter the poultry house (dogs, cats, etc.).
20. No visitors, servicemen, feedmen, salesmen, or neighbors are to be allowed into the poultry houses at any time.
21. A log book will be kept, listing the authorized persons that entered the houses, the date, and the time.
22. Caretakers shall not visit permises where other poultry are kept or poultry products are processed.
23. None of the members of the caretaker's household shall work or provide service on premises where poultry is kept or poultry products are processed.
24. The cooperator agrees not to sell, trade, lease, or otherwise remove or dispose of birds without the permission of the disease control agencies, the State government, the ANHD officer, or the Department of Animal Pathology, University of Maine. These agencies will be notified 48 hours prior to taking birds to market.
25. Birds removed from the farm will go directly to a processing plant, where samples for disease studies will be obtained by the appropriate Government personnel.
26. Since blood samples or birds will be collected under the supervision of a veterinarian and the methods used are known to be safe and the birds will be under the care and management of the cooperator, no liability shall accrue to the disease control agencies in the event damages, or losses, or injury incidental to the handling of the flock.
27. The cooperator shall keep and provide the necessary records desired by the disease control agencies.
28. Mortality records and a report of any abnormalities in the health of the flock shall be kept by the caretaker.

On the farm whole blood PPLO testing was found to be cumbersome and inefficient. Trained laboratory personnel were not always available. The whole blood test was satisfactory as a "check"-type test, but did not appear useful for cleanup programs. Exploratory PPLO testing, using the serum plate method, was instituted in Maine during the first part of 1955.

Owing to the volume of PPLO tests requested by the industry and in order to establish a more efficient procedure of testing, the tube agglutination technique was adopted in August 1962.

SPF Broiler Program

The SPF Broiler Program followed the same set of rules of management and husbandry practices outlined for the SPF Breeder Program. One age group of chickens was grown on these farms under strict supervision and good isolation conditions. Blood from these growing flocks was random sampled at 4 and at 7 weeks of age on the farms. Between 9 and 10 weeks of age, the flock was processed and a representative sampling of blood was collected for testing purposes. The following tests were run on the blood samples: (1) serum-neutralization test for bronchitis, (2) HI (hemagglutination-inhibition) for Newcastle disease, (3) tube test for pullorum--typhoid, and (4) tube test for PPLO-S_6. Condemned birds were observed, and in the event of a flock problem representative tissues were collected and examined histologically to document the disease condition.

On completion of all tests a report was sent to the grower, if requested, and to the manager of the cooperating poultry company, and one report was placed in the master file of the laboratory of the University of Maine. The poultry company was kept advised at all times on errors observed in management and sanitation during the growing of these flocks. Where disease outbreaks occurred, an attempt was made to trace the source or sources of these outbreaks.

CONCLUSIONS AND RESULTS

1. Bronchitis has been a problem during the growing period, especially from January to May. Twenty-five percent of the broiler flocks have been affected.
2. Newcastle disease has not been a problem in SPF flocks. Only 2 flocks comprising 44,500 birds over a 3-year period, have been affected.
3. Outbreaks of viral respiratory diseases seem to stimulate the growth of PPLO infection in infected flocks.
4. Hatchery vaccination, transferring of feeds from infected houses to noninfected houses, rodents, debeaking crews, visitors, and poultry trucks have all proved to be sources of bronchitis outbreaks.
5. PPLO-free birds grown under average management and sanitation conditions remain clean throughout the growing period (9 to 13 weeks) (500,000 birds random tested).
6. One poultry company has eradicated PPLO-S_6 infection from its breeding flocks. This company is now placing 200,000 clean chicks weekly on the growing program. This eradication program has taken 3 years to complete.
7. Eradication of PPLO infection from the broiler chick has reduced condemnations from airsacculitis to almost zero.
8. The incidence of leukosis infection in broiler flocks has been increasing since February 1964.
9. Flock performance on the SPF program has proved to be superior to flocks not participating on the program.
10. In several instances problem growers were placed on the program, and the overall performance of their flocks was much improved.

11. PPLO-free SPF flocks grew better than PPLO-free non-SPF flocks. PPLO-free SPF flocks had better feed conversions, heavier weights, and less condemnations. The livabilities remained about the same.

Most progress noted in the program was the eradication of PPLO-S_6 infection from one integrated company's broiler operation. It was also shown that broiler flocks can be grown economically on a practical field basis without benefit of vaccinations or medications (antibiotics). In a 1-year period, this meant a saving of $110,000 to one integrated company.

The SPF program is going to be expanded to include at least one other integrated company and several new flocks in 1964-65. Work has been started with this company in the area of PPLO eradication. Twenty-five new broiler houses are being built for an SPF program. A continuing study will be made of the growers now participating in the program, with special emphasis being placed on disease transmission studies, PPLO-free flock performance, leukosis studies, and environmental control. More epidemiological investigations are being planned, and more emphasis will be given to publicizing the program.

More supervision in the area of cleaning and disinfecting of poultry houses is to be attempted. Some type of program that will interest the poultry industry in the cleaning and disinfecting of poultry trucks and coops after their use at the processing plants would be a great step forward in the reduction of poultry diseases.

INFECTIOUS SINUSITIS PROGRAM--MINNESOTA

Infectious sinusitis, a respiratory disease of turkeys, has been one of the most serious problems to the Minnesota turkey industry. It produces infections in airsacs and lungs and often results in damage to the carcass, which makes it unacceptable for processing.

In the past this disease has been known to cause as high as 55 percent of all turkey condemnations in the processing plant. In 1961, before Minnesota had a voluntary control program, one-quarter million turkeys were condemned because of airsac infection alone.

In 1960 a group of industry representatives, university scientists, State and Federal disease control veterinarians, in cooperation with the poultry inspection service, conducted a study of the cause of these condemnations in turkey processing plants in Minnesota and Wisconsin.

Field investigations in Minnesota showed that flocks actively infected with infectious sinusitis had condemnations ranging from 1.5 to 85 percent at the time of processing.

HISTORY OF DISEASE

Tyzzer (10)[1] first recognized the disease in the United States. In 1938, Dickinson and Hinshaw (1) called it infectious sinusitis. Markham and Wong (6) succeeded in propagating important etiological agents and identified them as pleuropneumonia-like organisms (PPLO) recognized by most investigators as the organism identified with chronic respiratory disease (CRD) in chickens. Mataney (7) and Van Roekel et al., (11) and Osborn and Pomeroy (8) compared the disease in turkeys with CRD in chickens.

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[1] Underscored numbers in parentheses refer to Literature Cited on page 13.

DESCRIPTION OF THE DISEASE

A pleuropneumonia-like organism, known as *Mycoplasma gallisepticum*, is generally accepted as the causative agent of the sinusitis and airsacculitis associated with this disease. The organism is similar, if not identical, to the one associated with chronic respiratory disease in chickens. *Mycoplasma* are small gram-negative organisms with very fastidious growth requirements, and because they have no cell walls they are easily destroyed outside the host by drying and by disinfectants.

Symptoms

Sinusitis is usually first manifested by the birds shaking their heads in an attempt to remove the mucous exudate from their nostrils. The feathers become soiled and sticky from the combination of exudate, dust, and litter that adheres to the feathers. Watery secretions commonly appear from the eyes. The most dramatic sign is the swelling of the intraorbital sinuses. When sinusitis is present, it is usually possible to squeeze a tenacious sticky, gray exudate from the nostrils or through the palatine tissue on the roof of the mouth. The swelling of the sinuses may continue to enlarge until the eyes either partially or completely close. The open-mouth breathing may be a result of a complete blocking of the posterior nares or a result of severe air sac involvement, or both. Birds caught and held with the head down may die suddenly from lack of air caused by a tracheal blockage with mucous exudate. The affected turkeys continue to eat as long as they can see to find the feed, but become thin and depressed.

Heavy breathing, coughing, and sneezing are common symptoms of the lower respiratory form. As the disease progresses, the breathing becomes noisier. There may be respiratory rales and panting. The head may become cyanotic (blue from lack of oxygen). The lungs are inflammed, and the air sacs become thickened and cloudy and filled with a semigelatinous foamy exudate that later becomes "cheesy."

Transmission

Infectious sinusitis has been transmitted experimentally by injecting the infective material into the infraorbital sinuses. Field observations show that the disease is airborne and that duststorms play an important role in transmission. Hinshaw (2) has found that airborne transmission of the disease is more likely to occur if the lower respiratory form is prevalent. In experimental as well as field observations, Jerstad and coworkers (4,5) concluded that the infected breeders may transmit the disease to some of their progeny. There is additional evidence of egg transmission (3, 7, 9).

Mortality

The contagious type of infectious sinusitis runs a chronic course and may exist in a flock for weeks. Although the number of deaths may be less than in some more acute diseases, the financial loss may be greater. Failure of the birds to gain weight results in high financial loss.

PRELIMINARY FIELD STUDY

Two investigations were made by the University of Minnesota and the U.S. Department of Agriculture Extension Service in late 1960 to determine if there were any significant differences in the history or handling during the growing period between turkey flocks with high condemnation rates and those with low condemnation rates. Little variation in management and environmental factors between low and high condemnation flocks was apparent. Six to eight flocks with condemnation rates over 3 percent had a history of infectious sinusitis, or at least a respiratory condition. Although the results of the investigations were designed to locate the problem areas, they suggested that--

1. Infectious sinusitis could cause high condemnation rates in individual flocks and was, therefore, a flock problem; and
2. There are causes of airsacculitis other than infectious sinusitis.

CONTROL PROGRAM

Program Objectives

The objective of the Minnesota program is to eradicate infectious sinusitis in turkeys caused by Mycoplasma gallisepticum, thereby eliminating losses suffered by the industry due to mortality, morbidity, and condemnations at time of slaughter.

Pilot Study First Year

On May 1, 1961, the Minnesota Infectious Sinusitis Pilot Program was initiated, based on principles and concepts developed during the investigation period. These principles were:

Breeder flock owners were encouraged to select birds from grower flocks that had not had any history of respiratory symptoms or from flocks that were examined or tested and found free of infectious sinusitis.

All breeder hens and toms were tested by the serum plate test for PPLO-S_6 at the time the pullorum--typhoid test was conducted at the State field laboratory. Birds that reacted were presented to the University laboratory for necropsy, further serology, and bacteriological examination. Final determination was made on these latter findings. If a bird was found infected, the entire flock was discarded for breeding purposes.

Somewhat later, the serum plate test was used as a screening device. Screen positive or suspicious birds were subjected to the hemagglutination-inhibition (HI) test at the field laboratory, and only the HI positive or suspicious birds were submitted to the University laboratory for necropsy and for culturing.

For the program, approximately 100 breeder flocks were selected from 13 hatcheries throughout the State, and these flocks were subjected to the following procedures.

1. They were random sampled (10 percent or 100 birds) twice after the 100 percent test;
2. They were visually inspected twice during the production (laying) period;
3. As many as possible were examined for air-sac pathology at the processing plant;
4. Epidemiologists routinely checked farms where progeny breeders under this program were being grown to determine if they remained free from infectious sinusitis; and
5. Epidemiologists investigated all clinical outbreaks of infectious sinusitis to determine cause and source of break, if possible.

The purpose of the third procedure was to determine--

1. If the 100 percent test was detecting all birds infected with infectious sinusitis;
2. If infection was latent and clinical evidence would appear after stress;
3. If flocks were becoming infected after testing; or
4. If breeders testing negative and demonstrating no clinical symptoms would exhibit air-sac lesions at time of slaughter.

During the first year of the pilot program (1961)--

712 flocks containing 663,177 birds were 100 percent tested for PPLO;
251 flocks, or 35.3 percent, demonstrated some reaction to the plate test;
236 flock inspections for clinical signs of the disease were made and 33 flocks observed at time of slaughter;

9 (breeder) flocks showed clinical or serological signs after they had been clean on the initial 100 percent test. The number of flocks eliminated after preselection examination and tests is not known.

Pilot Study Second Year

Beginning May 1, 1962, the recommendations to breeder flock owners were the same as the previous year; eliminate or pretest birds having a history of respiratory symptoms before selecting breeder birds. All breeder flocks were again tested 100 percent by the serum plate test. Positive and suspicious birds were retested by the HI test and those reacting to this test were submitted to the University of Minnesota laboratory for necropsy and culture.

Approximately one-third of the breeder flocks from 35 hatcheries participated. Of a total of more than 200 flocks involved, each was random sampled 10 percent and inspected visually at least once during the laying period. At the processing plant pathological examinations were made on as many flocks as possible.

Since the breeder flocks in Minnesota were scattered throughout the State and the volume of inspections to be made was large, State and Federal veterinarians were assigned to make inspections in their respective areas and to make or coordinate the processing plant observation.

All grower birds from Minnesota breeder flocks were progeny of dams that had been 100 percent tested, so the growers were closely observed and followed to determine the program efficacy in controlling infectious sinusitis. Many flocks were inspected and re-inspected, random sampled for serology, and examined at time of processing. Epidemiological studies were again conducted on all clinical manifestations of respiratory diseases.

Outline of the Program

At its annual meeting early in 1963, the Breeder Hen Committee of the Minnesota Turkey Growers' Association agreed that the pilot program was sound and had greatly benefited the growers. The association proposed to the Minnesota Livestock Sanitary Board that the program be made an official program. Regulations were drafted and approved by the State attorney general to become effective on July 1, 1963.

The program was a voluntary one; however, it has at present 100 percent participation on the part of flock owners and hatcherymen. Basically, it is built around 100 percent test for *Mycoplasma gallisepticum* with a single flock inspection made by a State or Federal veterinarian sometime during the egg production period. Random sample testing is done only when there is evidence of respiratory disease in a breeder flock as determined either by the owner or by the inspecting veterinarians. The designation of "Minnesota *M. gallisepticum* Tested Flock" is awarded a breeder flock that is negative on necropsy, additional serology, and culture. A "Minnesota *M. gallisepticum* Test Hatchery" is one operating under board supervision and hatches and handles eggs and poults originating from "Minnesota *M. gallisepticum* Tested Flocks," or flocks of comparable status.

A flock is considered positive and discarded for breeding when reactors are designated at the University of Minnesota laboratory by one of the following criteria:

1. Active air-sac lesions.
2. Recovery of *M. gallisepticum* organism.
3. Supplemental serological tests.

This is a cooperative program with the Minnesota Turkey Growers, the Minnesota Livestock Sanitary Board, the University of Minnesota, and the ADPR and ANH Divisions, ARS, USDA.

The Minnesota turkey industry pays 2 to 3 cents per bird tested for *M. gallisepticum*. The money is used to offset operation costs, antigen production, and part of the research. The industry also makes outright grants for research to the Agricultural Research Station at the University of Minnesota. The Minnesota Livestock Sanitary Board does the testing at their regional laboratories. State and Federal field veterinarians make flock inspections.

The Department of Bacteriology and Public Health, College of Veterinary Medicine, University of Minnesota, has initiated the research that has gone into the program, does most of the diagnostic work when further diagnosis is needed, and, until recently, has produced the antigen for testing.

The ADPR Division, ARS, USDA, has furnished funds for research. The ANH Division, ARS, USDA, assists in administering the program, aids in the diagnosis, does the epidemiology, and makes flock inspections. Drs. Claude Pfow, James Moulthrop, and Earl Grass, ANH Poultry Epidemiologists, have been assigned to coordinate the field phase of the program.

PROGRAM PROGRESS

During the first year of the official M. gallisepticum program there were 764 turkey flocks tested containing 696,691 birds; each of these flocks was inspected once during the production season by State or Federal field veterinarians. By the test, no breeder flocks were found infected, and no flocks exhibited clinical signs at the time of inspection. Table 3 gives a comparison of test results between the first year of the official program and the last year of the pilot program. It is believed that the reduction of titers in the field testing has been due to a reduction of infection, the use of a more refined antigen, and possibly better interpretation of test results by laboratory personnel after 2 years' experience.

Three known clinical outbreaks of infectious sinusitis in the State occurred during 1964. One was in birds shipped into Minnesota from out of State, one was due to poults being infected when brooded in batteries in the same building with infected chickens, and in the third case the source of infection has not been determined. Two outbreaks thought to be from the same source are being investigated at the present time (1965).

TABLE 3.--Results of the Minnesota infectious sinusitis program, 1962-64

Item	Fiscal year	
	1963-64	1962-63
Birds tested----------------------number----	696,691	738,135
Positive SP* test-----------------number----	78	923
Susceptible SP test---------------number----	125	1,903
Positive or susceptible SP test---percent---	.029	.366
Positive or susceptible HI test---number----	41	384
Birds submitted to laboratory-----number----	34	228
Positive after all tests----------number----	0	29

*Standard plate.

FUTURE WORK

Presently, the plans are to continue the Minnesota M. gallisepticum program as it is. With the availability of a uniform diagnostic antigen, there will be more emphasis placed on compliance with the Minnesota program of imported hatching eggs.

Beginning July 1, 1964, a check is being made on all turkey breeder flocks to determine the prevalence of the "N" strain of Mycoplasma in Minnesota flocks. Work will continue to improve the egg-dipping technique in an effort to establish breeding flocks that are free of the "N" strain of Mycoplasma.

The poultry industry and appropriate agencies in Wisconsin have begun an official M. gallisepticum program. Iowa's official program should be in effect within a year. These programs are to be quite similar to the Minnesota program. It is possible that there could be a close working agreement between these three States that could form a nucleus and lead to unified programs aimed at the control of poultry diseases in other surrounding States in the future.

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THE AVIAN LEUKOSIS COMPLEX

Diseases of the avian leukosis complex (ALC) are increasing rapidly. The acute type of visceral leukosis affects young chickens and is becoming a serious economic problem to the broiler industry because of high condemnation losses at the processing plant.

Breeder flocks and commercial egg flocks suffer high mortality from the disease.

HISTORY OF THE DISEASES

Diseases of the avian leukosis complex that cause large losses in commercial poultry are visceral lymphomatosis, neural lymphomatosis, and osteopetrosis. All are caused by viruses; however, it is not known if each neoplasm is caused by distinctly different viruses. The virus causing visceral lymphomatosis is transmitted both by the fertile egg and by bird-to-bird contact. The presence of the virus, as indicated by several surveys, is widespread among commercial flocks. In spite of this, mortality for visceral and neural lymphomatosis varies widely among different flocks. In "acute" outbreaks mortality of 15 to 30 percent may occur in a period of 6 weeks.

Experimentally, the occurrence of neoplasia in susceptible, nonimmune chickens is directly proportional to the virus dose. It is also related to variations in virulence of the virus, age of bird at any time of exposure, and the level of active and passive immunity. However, there has been much discussion on the possible importance of secondary factors, such as physical and biological stressing agents.

INDIANA FLOCK STUDIES

Project

A naturally occurring avian tumor and virus (avian leukosis complex) was investigated in selected chicken populations and non-avian contact species.

The participating and cooperating agencies were the Field Studies Area, National Cancer Institute, U.S. Public Health Service; Regional Poultry Research Laboratory, Animal Husbandry Research Division and Animal Health Division, ARS, U.S. Department of Agriculture; and the American Poultry and Hatchery Federation.

The factor or factors immediately responsible for such marked variations in the rate of neoplasia in the field have not yet been made clear. It would seem highly important to obtain data that will provide the necessary evidence to determine whether or not the primary factors--(1) virulence of the virus, (2) the level and time of exposure, (3) the level of active immunity, and (4) the level of passive immunity--determine the role in the high incidence of neoplasia, or whether other factors--genetic, nutritional, environmental or predisposing agents--are significant. The study of these factors and their interaction form the basis of this project.

Outline of the Program

Paired farms are being selected in northern Indiana for the avian leukosis project--one farm with a past history of leukosis and one farm with a history of very little or no leukosis. A hatch of Leghorn chicks is randomized and started on the two farms the same day. One hundred of the chicks in each house are identified by wing bands. One hundred indicator chicks from the Regional Poultry Research Laboratory are wing banded and put in each house. These indicator chicks are known to be leukosis free but are very susceptible to leukosis.

Blood plasma samples are taken from all surviving banded birds at four different intervals for virus isolation and antibody analysis at the Regional Poultry Research Laboratory.

All birds that die in the experimental flocks are being autopsied for evidence of leukosis. The Animal Health Division, ARS, has established a mobile laboratory at Milford, Ind., for the use of D. C. Johnson, district veterinarian and poultry epidemiologist, in the autopsy of birds and other necessary field laboratory work. Dr. Johnson supervises the field part of the project.

H. G. Purchase, research veterinarian, is doing all supporting histopathology work. He and other staff members of the Regional Poultry Research Laboratory also assist in the field when help is needed. Differing management practices are recorded as well as any other data that might be useful.

Project Progress

The first two pairs of flocks were established on May 28 and 29, 1964. Each flock consisted of 3,000 Leghorn pullets. After 7 months one flock had 36 percent mortality, most of which was from leukosis. The flocks are to be kept in the project several more months.

The goal is to work with five pairs of flocks or more by the end of fiscal year 1965.

Another field study on the effects of "growth hormones" on avian leukosis complex (ALC) mortality in rooster chickens was conducted.

We are unable to draw any significant conclusions from this project due to the small difference in leukosis incidence between the two flocks.

MICHIGAN EPIDEMIOLOGICAL STUDIES

This project is coordinated from the USDA Regional Poultry Research Laboratory in East Lansing, Mich., involving studies on the avian leukosis complex, especially the acute form that is a serious problem in the broiler industry. The purpose of the project is the collection and analysis of statistical epidemiological information on flock management and disease control. Through cooperative agreement between the Regional Poultry Research Laboratory and the Animal Health Division, ANH personnel carry out the field phase of the program. The information is collected through field investigation of currently affected and nonaffected flocks, and by utilizing flock records from the poultry industry. The information gathered is tabulated on data processing machines. Conclusions will be used to guide future experiments at the Regional Poultry Research Laboratory and the development of recommendations to the industry on disease control.

Arrangements were made to obtain epidemiological case reports from over 150 farms in 12 states. The data is still being analyzed; consequently, no report of findings or conclusion can be made at this time.

Dr. Ralph Muhm, ANH Poultry Epidemiologist, working in cooperation with Dr. Ben Burmester and others, is coordinating and evaluating the studies.

THE VIRGINIA BROILER PRODUCTION IMPROVEMENT PROGRAM

The need for a program directed at the growing phase of poultry in Virginia has been recognized for a number of years; however, no formal program had been attempted prior to the spring of 1963, when the Virginia Broiler Production Improvement Program was started.

Initiation of the Broiler Production Improvement Program was at the request of the poultry industry after the publication of a report by H. W. Sawyer, coordinator, Poultry Disease Control Programs, Virginia Department of Agriculture. The report was the final result of a study begun in March 1961 of poultry condemnations and their causes. During this particular phase of the study, records of the Inspection Branch, Poultry Division, Consumer and Marketing Service, USDA, were examined and data compiled as to the cause of condemnation, approximate age, and weight of birds condemned.

As a result of the study much factual information became available. Probably the most startling finding was that 10 percent of the poultry flocks accounted for 49 percent of all condemnations for respiratory disease. Obviously, this was one segment of the industry that could stand vast improvement. It was at this 10 percent of "poor-growers" that the Broiler Production Improvement Program was directed.

Other important information that evolved from the 1961-62 study:

1. Large numbers of poultry were dead on arrival at the plant.
2. Respiratory diseases were the major cause of all condemnations.
3. Leukosis was rapidly increasing as an important cause of condemnations.
4. The amount of poultry condemned because of bruising on the farm was insignificant.

5. Plant-caused condemnations were low.
6. The inspection criteria were uniformly followed.
7. Housing and management needed improvement.

OBJECTIVES

The primary objective was to improve broiler production. Specifically, better housing, equipment, and management should result in less disease and medication expense and faster weight gains with less feed and lower condemnations when processed for the market.

PLAN OF WORK

Poultry contracting firms were contacted and asked to submit names and records of their "poorest" growers. After a review of a grower's past production record, his farm was surveyed to determine available floor space, if feeding and watering equipment were adequate for the number of birds that could be grown on the available floor space, and if the poultry house was in need of repair.

H. W. Sawyer and J. S. Dawson, Virginia Department of Agriculture, and W. S. Thompson, Animal Disease Eradication Division, ARS, U.S. Department of Agriculture, were responsible for making farm inspections prior to and after the grower agreed to participate in the program. Inspections were made weekly, beginning on the chick-arrival date and continuing until all poultry was marketed. During each inspection an effort was made to counsel the caretaker in areas of management and disease prevention. In addition, handling, loading, and evisceration procedures were observed when the flock was marketed.

PROGRESS

1. Average condemnation losses of the 27 participating flocks was reduced from 2.37 percent to 1.06 percent.
2. It took an average of 2.28 pounds of feed to produce a pound of chicken before growers joined the program, but only 2.19 pounds while on the program.
3. Medication costs were reduced 10 percent, from 0.21 to 0.19 cents per pounds of meat marketed.
4. Broilers dead-on-arrival at the processing plant decreased from 0.18 percent of the birds marketed to 0.11 percent, or 39 percent.
5. Gross profit increased 2.02 cents per chick started.

MARKET POULTRY IDENTIFICATION FOR ERADICATING AVIAN TUBERCULOSIS

This pilot study is being conducted by the Division of Animal and Dairy Industry, Virginia Department of Agriculture, cooperating with the Animal Health Division, ARS, U.S. Department of Agriculture.

The purpose of this project is to assist disease control specialists in identifying fowl found to be infected with avian tuberculosis at the poultry processing plants and tracing back to the farm of origin.

Upon completion of the pilot study these techniques will be used to find and eradicate avian tuberculosis in other States.

OBJECTIVES

1. To determine marketing practices followed by owners of "barnyard" lots of poultry, since barnyard fowl are usually allowed to live 2 or more years and are more likely to be infected with tuberculosis.
2. To locate foci of avian tuberculosis.
3. To determine by appropriate test whether other animals and poultry on the farm of origin are also infected with avian tuberculosis.
4. To determine the prevalence of avian tuberculosis in all classes of poultry and particularly old fowl.
5. To establish an effective method of "trace-back," which could also be used in studying the epidemiology of other poultry diseases such as leukosis and salmonellosis.

PLAN OF WORK

Questionnaires have been prepared for distribution, through the U.S. Federal Extension Service, to all farm families requesting information as to--

1. The number of birds usually kept on the farm.
2. Whether the flock runs loose or is confined.
3. The approximate age of the flock at present and the approximate number of years a flock usually remains on the farm.
4. The method of disposal of old hens:
   (a) Dressed for home use.
   (b) Dressed for retail farm sale.
   (c) Sold live to broker.
   (d) Sold live to processor.
5. Whether chickens are allowed to run loose with hogs and cattle.

PROGRESS

The response to the questionnaires was somewhat less than we expected but with the information they did provide, along with that obtained from other sources, we could state positively that there is no established marketing pattern for barnyard fowl in the state and that only a very small percentage of these fowl are processed under veterinary inspection.

As there are so few barnyard fowl processed under veterinary inspection, a trace-back system to determine the prevalence of avian T.B. was considered impractical and efforts to establish such a system were discontinued in favor of farm-to-farm testing. The results of farm-to-farm testing in two counties proved unsatisfactory for our purposes, making it necessary to alter our plan of work. Our new revised approach will allow us to better evaluate the significance of avian tuberculosis to the Bovine Tuberculosis Eradication Program. The objectives of this approach are:

1. To determine the incidence of avian T.B. in Grade A dairy herds selected at random.
2. To determine the incidence and correlation of avian T.B. in the cattle and chickens on the same premise.